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InnoBYG BYGGERI

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BRONE - Workshop I

Dronefacilitet til test af sensorer og dataopsamling for brug i dronebaseret inspektion af infrastruktur og byggerier

Teknologisk Institut - Forskerparken 10F, 5230 Odense. April 4th 09:30-14:30

BRONE - Workshop I: Agenda

09:30 to 09:45   *Welcome to the Robot Centre*

09:45 to 10:15   *Tour in the Robot Centre facilities*

10:15 to 11:30   *Discussion on the BRONE activities*

11:30 to 12:15   *Lunch*

12:30 to 13:00   *Transport to HCA Airport*

13:00 to 14:00   *Walkthrough HCA airport test facilities*

14:00 to 14:30   *Workshop - wrap up*

General notes and Introduction

Workshop participants:

- Note: The name and details of the participants are omitted in the public document

Welcome to new SMEs:

- Dansk Drone Kompagni

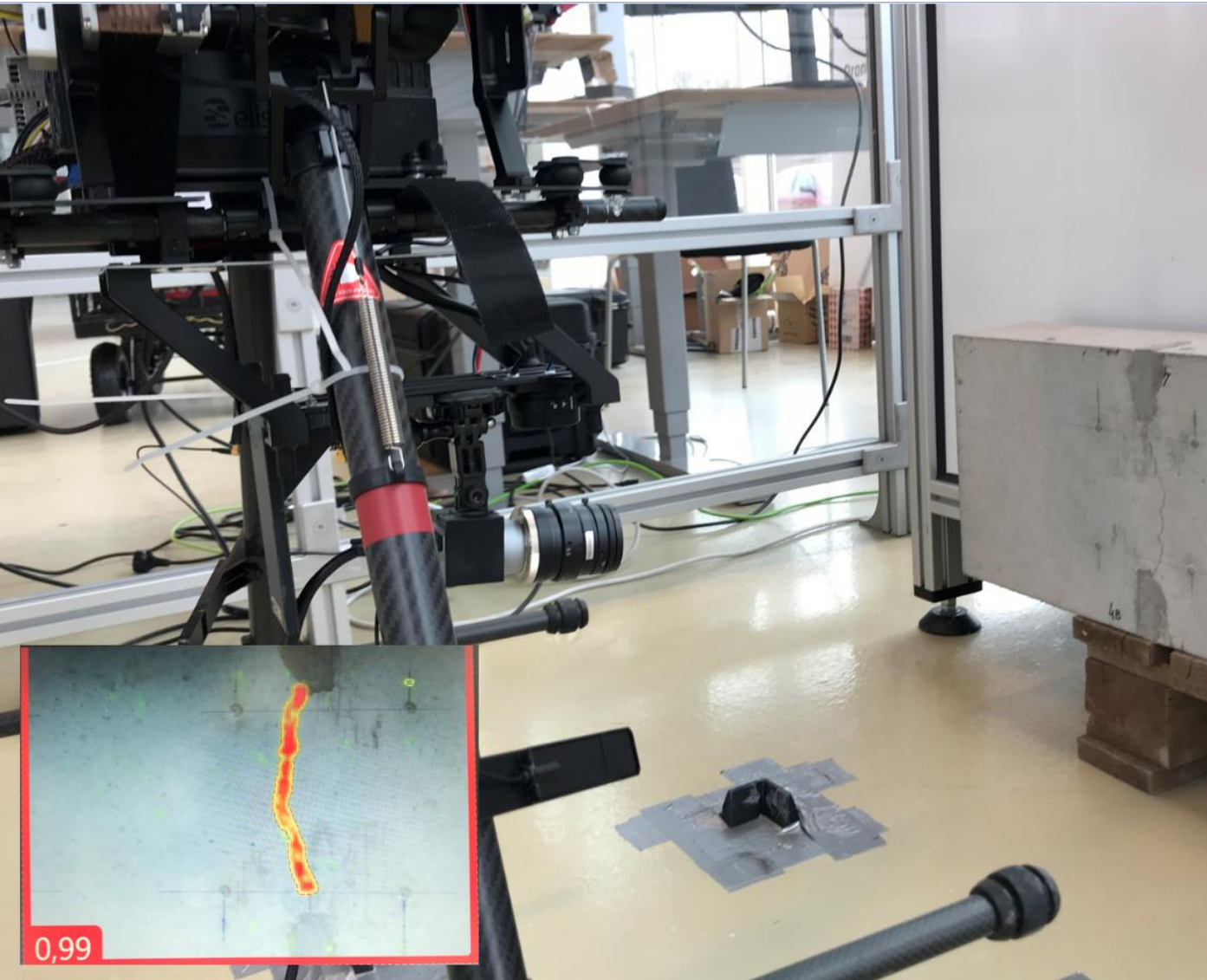- Drone Harmony

Project participants:

- EasyInspekt

- DroneInspektion

- Randers Tegl

- Scopito

- Spotland

- STO Danmark

1. Robot Centre facilities

1. Artificial Intelligence-based crack detection system (under development)

2. Robot cell for controlled tests: drone flight simulation

2. BRONE: Activities & Goals

FUNDAMENTAL OBJECTIVES:

a) establish a reference facility for test and development of drone-based inspection

b) **experiment by testing drone-based inspection technologies**

c) **share knowledge by providing a space where companies can promote their technologies**

d) **foster new research and product development ventures**

PROJECT ACTIVITIES:

1. Establish reference test facility with concrete or masonry samples

2. **Perform conventional drone inspection of test samples**

3. **Perform an open drone inspection hosted by a project participant**

4. **Establish guidelines and parameters for use of reference samples**

5. Demonstrate a novel-automated inspection concept   [M7-10]

6. Demonstrate a concept for degradation model   [M8-12]

2. BRONE: Timeline

The project comprises the following activities: [Months: M1-M12]	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
1. Establish reference test facility with concrete or masonry samples [M1-3]		_Complete_										
2. Perform conventional drone inspection of test samples [M3-4]				_In progress_								
3. Perform an open drone inspection hosted by a project participant [M3-5]				_In progress_								
4. Establish guidelines and parameters for use of reference samples [M4-6]					_In progress_							
5. Demonstrate a novel-automated inspection concept [M7-10]												
6. Demonstrate a concept for degradation model [M8-12]												
Milestone 1: Kick-off meeting, [M1, 15.11.17]	x											
Milestone 2: Document mock-up to be monitored, [M3, 31.01.18]			x									
Milestone 3: Drone inspections & sensor tests are finalized, [M10, 31.08.18]										x		
Milestone 4: Project workshops are finalized [M11, 31.09.18]											x	
Milestone 5: Final presentation at Inno-Drone conference, [M12, 01.11.18]												x

Activity 2-4: The samples to be produced will depend on which technology will be tested

3. BRONE: Activity 2 (Development)

WHICH TECHNOLOGY DEVELOPMENT SHALL WE FOCUS ON?

Artificial- Intelligence-based inspection →detecting anomalies in concrete/masonry;

LIDAR and other sensors →monitoring relative deformation on existing structures;

Thermal cameras →heat-maps of concrete elements produced in slip forming (on-site QC);

Measurements of façade elements →alignment/surface area in existing buildings QC/BIM);

Based on the meeting discussion, the most relevant topics are <u>AI-assisted inspections for crack detection</u> and the use of <u>thermal cameras</u>. The former represents the innovation part of the project (new technology), whereas the later provides new insights for creating multi-layer models (where RGB and Thermal images are combined into one model). Jørgen (DTI) presented a case of a traditional building inspection in Aarhus where a drone equipped with thermal camera could be of advantage. The BRONE participants can work on two fronts: inspection of a concrete elements that will placed in the test facility (as part of Activity 2) and an inspection of a building façade (as part of activities 2 and 3).
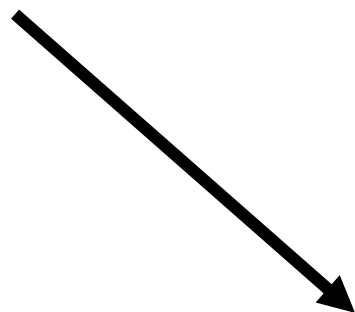
3. BRONE: Activity 2 (Development)

LARGE-SCALE SAMPLES TO BE PLACED IN THE TEST FACILITY?

3. BRONE: Activity 2 (Development)

EXAMPLES OF LARGE-SCALE CONCRETE SAMPLES – PRODUCED AT DTI'S CONCRETE CENTRE

Challenge: our budget can be a limitation on the scale of the sample and the number of standard tests we can perform (ongoing discussion)

4. BRONE: Activity 3 (Business-as-Usual)

DRONE INSPECTION HOSTED BY ONE OF THE PROJECT PARTICIPANTS

Open invitation to companies to join a drone inspection or survey with focus on inspection procedures and good practice. The main idea is to share knowledge – a simple visit from "Participant A" to "Participant B", e.g. Spotland visiting EasyInspect and understanding the way they handle data would be a great example for the project.

Suggestions:

- *the tools provided by EasyInspekt and/or Scopito could be used to document the results of the selected drone inspection – showcasing synergy between the project participants*

- *We can simplify A3 to a set of slides (open access data or models) highlighting a case where the companies feature an application of their technology, e.g. indoor laser scanning*

- *The façade case presented by DTI (see next slide) could also be an interesting way to have an "open drone inspection".*

4. BRONE: Activity 3 (Business as Usual)

**SELECTED IMAGES FROM THE CASE STUDY PRESENTED BY DTI**
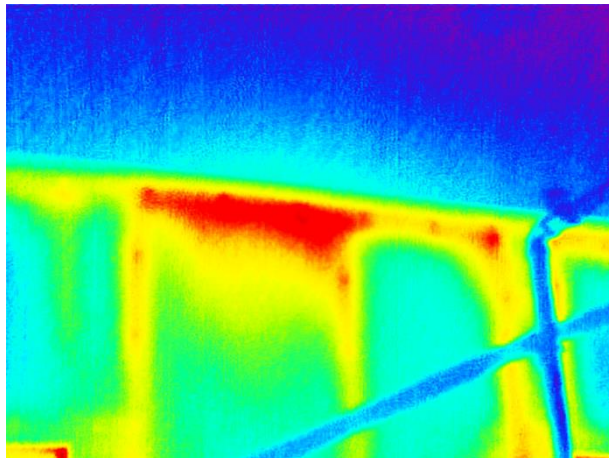
Case study: (Performed using a traditional approach)
In a nutshell, a hand-held camera was used to identify cold bridges in façade panels of a building. The heat spots in the image indicate the steel profiles used to support the façade elements.

Suggestion: (Drone-based inspection)
A similar inspection could be performed with a drone equipped with a thermal camera – the interesting part would be to overlay the thermal model with a model generated from RGB images. The workflow for such case could be an interesting application in Activity 3. This possibility will be investigated (pending approval)
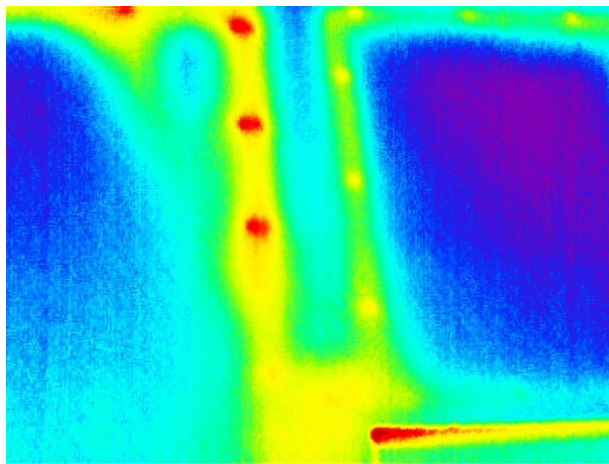
6. BRONE: Project deliverables (Status)

1-page article to be published on the Build 4.0 platform with a project description

1 Open invitation to companies to join a drone inspection or survey

1 **promotional video** and article featuring the project activities and results

1 **presentation** featuring the project results at the InnoDrone Conference in late 2018

½-page article with a project description on InnoByg's LinkedIn group

➡ **2-pages** report with results from the conventional drone inspection of the test samples   *Status: Upcoming (Samples being prepared)*

➡ **4-pages** report of an experimental case study on mock-ups featuring one of the automated inspection concepts

2-pages report on general concept on how to implement data from drones into deterioration modelling

1-page article with a summary of project results

Workshop 1 – "Drone Inspections and brainstorming" (Taking place on 04.04.2018 in Odense)

Workshop 2 – "Prospects and Lessons from the BRONE project"

Green: Complete ; Orange: In progress

7. BRONE: Dissemination

COLLECT CASE STUDIES FROM PARTICIPANTS – Short article on LinkedIn and Build 4.0 platform.

Examples:

- Drone Harmony: *Easy Workflow For Centimeter-precise Road Inspections in Difficult Terrains*

- Teknologisk Institut: *Concrete Inspection Tool Combining Tethered-drones And Machine Learning*

If there is a case you want to promote, please email wrls@dti.dk